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The Effects of Listener Training on the Emergence of Tact and Mand Signs by Individuals with Intellectual Disabilities

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The purpose of the current study was to assess whether individuals with intellectual disabilities would emit untrained speaker responses (i.e., signed tacts and mands) after being taught listener behaviors. Listener relations were trained via an automated matching-to-sample (MTS) procedure. Following mastery, the emergence of signed tacts, generalized tacts, and mands was tested. All participants met criterion in listener relations training and showed the emergence of almost all relations. Results suggest that teaching listener relations first, through MTS tasks, is a viable way to produce emergence of speaker relations.

Key words: sign language, tact, mand, conditional discrimination, intellectual disabilities

Some studies conducted with typical and language delayed individuals have suggested functional independence among vocal (e.g., Lamarre & Holland, 1985), signed (e.g., Hall & Sundberg, 1987), and selection-based (e.g., Rehfeldt & Root, 2005) tacts and mands, as well as among other vocal verbal operants (e.g., Miguel, Petursdottir, & Carr, 2005). On the other hand, other studies (e.g., Petursdottir, Carr, & Michael, 2005) have demonstrated that the manipulation of motivating operations (MOs; Laraway, Snycerski, Michael, & Poling, 2003) may facilitate functional interdependence between mands and tacts because the stimulus that reinforces the mand also serves as the antecedent variable that evokes the tact (Skinner, 1957).

Functional independence is also observed between speaker and listener repertoires in some individuals (e.g., Horne, Hughes, & Lowe, 2006). Despite this evidence, the emergence of listener behavior from speaker behavior training (e.g., Fiorile & Greer, 2007), as well as the emergence of vocal (e.g., Greer, Stolfi, Chavez-Brown, & Rivera-Valdez, 2005) and signed (e.g., Elias, Goyos, Saunders, & Saunders, 2008) speaker behavior from listener behavior training, have been observed.

In one of the few studies evaluating the emergence of signed speaker behavior from listener training, Elias et al. (2008) assessed the emergence of signs after 7 adults with intellectual disabilities (4 of whom were also hearing impaired) were trained on conditional relations among signs, pictures, and printed words. The results suggested that learning to select a picture or a printed word in the presence of the corresponding sign in a matching-to-sample (MTS) task was sufficient to produce the emission of some signs in the presence of a picture or printed word.

The current study was designed to extend these findings by assessing the effects of listener relations training on the emergence of signed tacts and mands. Besides being of theoretical interest, the emergence of untaught speaker behaviors could aid in the development of efficient curricula to teach verbal behavior to individuals with intellectual disabilities.

Listener relations were trained through the MTS procedure. After criterion was met on listener relations training, the emergence of signed tacts in the presence of pictures was tested. Furthermore, tests were conducted to verify whether those signs would emerge as mands. During mand tests, MOs were manip-

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Table 1
Stimuli and experimental responses presented in sets

Set A (sign videos)	Set B (pictures)	Set C (objects)	Set A′ (participants' signs)
A1	B1 	C1 = safe box	A′1
A2	B2 	C2 = key	A′2
A3	B3 	C3 = bottle	A′3
A4	B4 	C4 = opener	A′4
A5	B5 	C5 = box	A′5
A6	B6 	C6 = straw	A′6

ulated to test the transfer of nonverbal stimulus control to the conditioned MOs. This was accomplished by presenting an object containing a preferred item, but the tool needed to allow access to the item was withheld.

METHOD

Participants

Two individuals with intellectual disabilities, Peter (16 years old) and John (20 years old), who attended a special education school in the state of São Paulo, Brazil, participated in the study. They were selected because their vocal repertoires were predominantly characterized by unintelligible sounds. They had no previously known experience with Brazilian sign language (LIBRAS). However, they had appropriate motor skills to perform the signs and prior experience with identity MTS tasks.

Peter had an IQ of 52 (Wechsler Adult Intelligence Scale) and a diagnosis of moderate intellectual disability and cerebral palsy. He did not emit functional vocalizations. John had an IQ of 43 (Columbia Mental Maturity Scale) and a diagnosis of moderate intellectual disability and attention deficit hyperactivity disorder. He emitted only two-word utterances.

Setting, Materials, and Experimental Stimuli

Sessions were conducted in a room (2.5 m by 5 m) in their school that contained two tables, two chairs, and preferred items (description below). Only the experimenter and the participant were present in the room during sessions. Each session lasted approximately 5 min, and four to six sessions were conducted each day, two to three times per week, at approximately the same times.

MTS tasks were presented on a 15-in. computer monitor with the MestreLibras software (Goyos, Elias, & Ribeiro, 2005). During tact tasks, pictures were presented using Microsoft Power Point, and responses were recorded by a digital camcorder. In some conditions, red plastic tokens, which could be later exchanged for preferred items, were used as consequences for correct responses.

Three sets (A, B, and C), with six corresponding stimuli each, were defined (see Table 1). The six stimuli were chosen because they could be divided in pairs, and the objects of each pair were functionally related to each other: a safe box and a key; a bottle and an opener; a chocolate milk or juice box and a straw. Set A consisted of LIBRAS signs presented in 10-s digital video clips (Lira, 2001). Set B consisted of digitalized pictures. Set C consisted of the actual objects corresponding to the pictures of Set B. The set of responses A′ consisted of signed responses emitted by the participant that corresponded to Set A.

Dependent Measures

The main dependent measures were (a) the percentage of correct signed tacts (e.g., A′1) in the presence of either a picture (e.g., B1) or an object (e.g., C1), and (b) the percentage of correct signed mands (e.g., A′2) that

Table 2
Experimental Conditions Containing the Identification of the Relations, the Number of Trials by Task and the Probability of Reinforcement for Correct Responses

Condition	Trials by task	Relations	Probability of reinforcement
Mand pretraining	3	C1C2/C3C4/C5C6	100
Mand pretest	3	C1A′2/C3A′4/C5A′6	0
Tact pretest	6	BA′	0
Listener relations pretest	18[a]/12[b]	AB	0
Listener relations training (Stimulus Set 1)	18[a]/12[b]	A1B1/A3B3/A5B5	100
Tact Posttest 1	6	BA′	100
Listener relations training (Stimulus Set 2)	18[a]/12[b]	A2B2/A4B4/A6B6	100
Tact Posttest 2	6	BA′	100
Tact generalization test	6	CA′	100
Mand posttest	3	C1A′2/C3A′4/C5A′6	100

[a] Peter.
[b] John.

specified the missing object in the presence of an object that held a preferred item (e.g., C1).

Data were also collected on the percentage of correct selections during MTS training tasks. A correct selection was scored when in the presence of the sample (e.g., A1), the participant pointed to the correct comparison (e.g., B1) from a three-stimulus array (e.g., B1, B3, B5). Data on the number of correct selections were automatically recorded by the software.

Interobserver Agreement

During 40% of tact and mand tasks for each participant, a digital camera was positioned close to the participant in an unobtrusive manner. Data on signed verbal behavior were submitted to the analysis of an independent observer, who was blind to the purposes of the study. Point-by-point agreement was calculated by dividing the number of agreements by the sum of agreements and disagreements and multiplying by 100%. Agreement was 100%.

Experimental Design

A multiple probe design across two stimulus sets was used. The order of conditions was as follows: mand pretraining, mand pretest, tact pretest, listener relations pretest, listener relations training (Stimulus Set 1: A1B1, A3B3, A5B5), Tact Posttest 1, listener relations training (Stimulus Set 2: A2B2, A4B4, A6B6), Tact Posttest 2, tact generalization test, mand posttest (Table 2).

General Procedure

Preference assessment. Interviews with John and with Peter's parents were carried out to determine probable preferred items. Next, a paired-choice procedure (Fisher et al., 1992) was used to assess preference. Toys were used for Peter, and edible items were used for John. The items classified as highly and moderately preferred were placed on a table in view of the participant during sessions in which tokens were used.

Experimental Procedure

Mand pretraining. During this condition, participants were taught to use the specific objects: to use the key to open the safe box (C1–C2), to use the opener to open the bottle (C3–C4) and to perforate the box with the straw (C5–C6). Each trial started with the simultaneous presentation of a pair of objects from Set C and a specific instruction. The

instructions were, for Pair C1–C2, ''You can eat [exchange, for Peter] what is inside the safe box if you open it''; for Pair C3–C4, ''You can drink what is inside the bottle if you open it''; and for Pair C5–C6, ''You can drink what is inside the little box if you open it.'' A response was considered correct if the participant used the objects in an independent way, without the experimenter's help; otherwise, the response was considered incorrect. Correct responses were followed by access to the preferred item. Three trials were conducted, one for each pair of objects. All participants used the objects correctly during the first presentation of each pair.

Mand pretest and posttest. Each trial started with the presentation of an object from one of the pairs of Set C that held a participant's preferred item. These items were selected based on results obtained from the preference assessments. An edible item or a token was put inside the safe box (C1), a bottle containing a soft drink (C3), and a little box containing chocolate milk or juice (C5). Participants received the following instructions: ''You can eat [exchange, for Peter] what is in the safe box if you ask for what is missing to open it''; ''You can drink what is in the bottle if you ask for what is missing to open it''; and ''You can drink from the little box if you ask for what is missing to open it.'' Signed responses or vocal responses that specified the missing object, that is, key (C2), opener (C4), and straw (C6), were considered correct mands. If responses were not emitted within 5 s, the trial was considered incorrect and the next object was presented. During the pretest, no programmed consequences were presented. During the posttest, correct responses were followed by the delivery of the hidden object, and incorrect responses were followed by the next trial. During each condition, three trials were conducted, one for each pair of objects (C1, C3, C5).

Tact pretest, Posttests 1 and 2, and generalization test. At the beginning of each trial, a picture was presented in the center of the monitor or an object was placed on a table in front of the participant, and the instruction ''Do the sign for this picture [or object]'' was provided. Signs corresponding to the picture were considered correct responses. A sign was considered correct if the configuration, movement, and orientation of the hands were all performed consistently (Quadros & Karnopp, 2004). If the participant did not emit the sign within 5 s, or emitted a sign that did not show at least two of these characteristics, the response was considered incorrect and the next trial was presented. With exception of the pretest, in which no programmed consequences were provided, correct responses were followed by verbal praise and tokens that could be exchanged for a preferred item at the end of the session. Tokens could be exchanged only if the participant emitted all responses correctly. Sessions consisted of a six-trial block, one for each picture of Set B or Set C. In addition to the pretest, tact posttests were introduced after mastery criterion was achieved in the listener relations training for Stimulus Set 1 (Tact Posttest 1) and for Stimulus Set 2 (Tact Posttest 2). A generalization test was also introduced for the objects of Set C.

Prior to the generalization test, participants' tact performance was assessed to control for the possibility that subsequent failure during tact generalization and mand posttest was due to an inability to emit the signed tacts corresponding to the pictures in Set B. Participants were required to tact all pictures in a six-trial block. The emission of incorrect responses during the Tact Posttest 2 was followed by training through modeling for each sign.

Listener relations pretest and training (Stimulus Sets 1 and 2). During these conditions, AB relations were tested in two sets (Stimulus Set 1: A1B1, A3B3, A5B5, and Stimulus Set 2: A2B2, A4B4, A6B6). Each trial started with a sign presented by the video in the upper portion of the monitor. Signs were presented slowly so that configuration, movement, and orientation of the hands were clear. After presentation of the sign, the participant was instructed to touch the sample stimulus (i.e., observing response), which produced three pictures shown below the sample as comparison stimuli. The software was programmed to accept the observing response only after the video had been presented. During the pretest block, no programmed consequences were delivered. During training, the computer delivered consequences for correct and

incorrect selections. Correct selections were followed by computer animation, verbal praise, and a token provided by the experimenter. If participants responded correctly in all trials, tokens could be exchanged for a preferred item. Incorrect selections were followed by a blank screen for 2 s followed by the presentation of the next trial. Selections produced a 2-s intertrial interval. Mastery criterion established for each stimulus set was 100% of correct selections in a block. For Peter, each block was composed of 18 trials. For John, each block was composed of 12 trials, because 18 trials were too many to keep his attention. During a block, each sample stimulus was presented the same number of times and was not repeated more than two consecutive times. Each comparison stimulus appeared in the same position (right, middle, and left) on the monitor the same number of times.

RESULTS AND DISCUSSION

Figure 1 depicts the percentage of correct responses during tact pretest (BA′ relations), listener relations training (AB relations), tests for the emergence and generalization of tacts (BA′ and CA′ relations), and mand tests across stimulus sets for Peter (top) and John (bottom). Stimulus Set 1 consists of A1B1, A3B3, A5B5, B1A′1, B3A′3, B5A′5 and C1A′1, C3A′3, C5A′5 relations, and Stimulus Set 2 consists of A2B2, A4B4, A6B6, B2A′2, B4A′4, B6A′6 and C2A′2, C4A′4, C6A′6 relations.

For both participants, training relations between signs presented through video and pictures produced emergent signed tacts and mands. Mand pretest results showed that Peter emitted no correct responses and John emitted one correct vocal response for the key. However, neither of the participants emitted any tacts prior to the listener test. During the listener relations pretest, Peter and John performed at chance levels (50% and 39% correct selections, respectively). During training, Peter and John required four to nine sessions to meet criterion in the six listener relations. Tact posttest performances showed the emergence of all six signed tacts for Peter. Initially, John showed the emergence of only three signs, corresponding to safe box (A′1), key (A′2), and straw (A′6). In the second tact posttest, John showed performance deterioration of one sign (A′1). To train the nonemitted signs (A′3, A′4, and A′5) and the sign for which performance deterioration was observed (A′1), the modeling procedure was introduced. John required six to nine trials to meet criterion for the four signs. After this additional training, John emitted all six signed tacts. Generalization of tacts for the objects of Set C was also observed. In addition, both participants showed 100% correct mand responses, with Peter emitting three signs and John emitting two signs corresponding to opener and key and a vocal response to straw. Of note, the sign for opener was followed by the corresponding vocal response. Because spoken words corresponding to the stimuli were never trained in the current study, it may have been the case that John learned these vocal responses as tacts or even mands through pre- or extra-experimental experiences.

The extent to which participants' manding repertoires benefited from tact training may be related to whether manding had already been established as a higher order operant (Rehfeldt & Root, 2005). Therefore, once an individual has many mands in his or her repertoire, teaching tacts may be enough for the emergence of those responses as mands. In the current study, it is possible that previous exposure to the matched pair may have served to transfer the function between the antecedent stimulus that evoked the previously acquired tact to the one that would reinforce the mand. Thus, the object itself may have partially controlled the verbal topography related to the missing item.

Of note, the presentation of signs through video clips as sample stimuli in the conditional discrimination task could be considered more analogous to an auditory–visual conditional discrimination than to a visual–visual conditional discrimination. Similarly to dictated words, the signed videos are also a product of a speaker's behavior (thus, verbal stimuli). Much like echoic stimuli, signs are transitory or dynamic, and typically are terminated before the presentation of the comparison stimuli. Green (1990) suggested that classes that include a dictated name as one of the members tend to form more readily than classes in which all of the stimuli

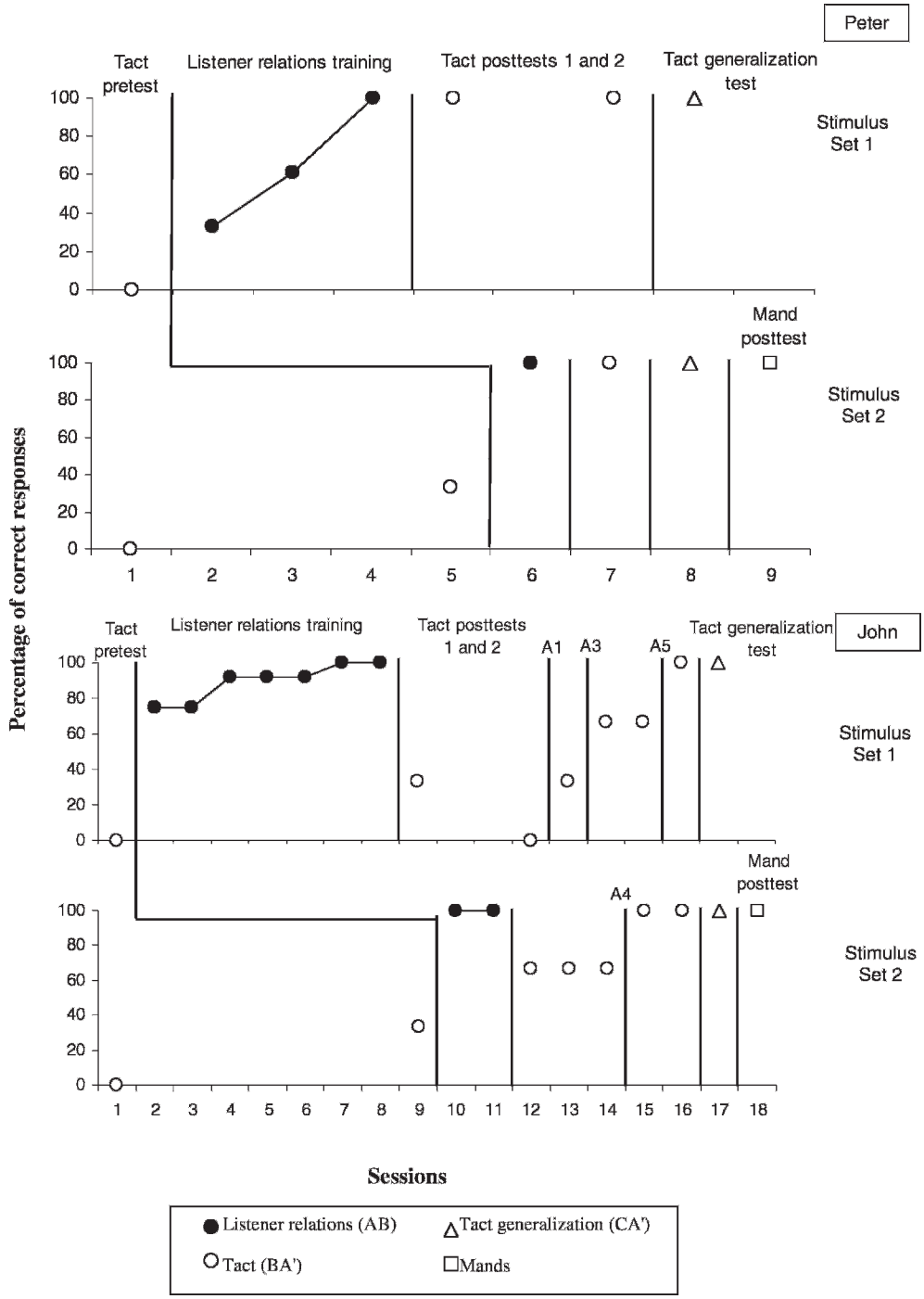

Figure 1. Percentage of correct responses during tact pretest (BA′ relations), listener relations training (AB relations), tests for the emergence and generalization of tacts (BA′ and CA′ relations), and mand tests across sets of stimuli for Peter (top) and John (bottom). The lines specified by stimuli from Set A refer to the sign training through modeling. Stimulus Set 1 consists of A1B1, A3B3, A5B5, B1A′1, B3A′3, B5A′5, and C1A′1, C3A′3, C5A′5 relations, and Stimulus Set 2 consists of A2B2, A4B4, A6B6, B2A′2, B4A′4, B6A′6 and C2A′2, C4A′4, C6A′6 relations.

are visual. An important question for future research is to investigate the role of response and stimulus topographies in the formation of stimulus classes, by comparing the presentation of signs and auditory and visual stimuli as samples.

Some limitations of the study are noteworthy. First, it is possible that mand performances were partially controlled by the specific instructions given during mand pre- and posttests. However, the instruction may have simply functioned as a contextual cue for the emission of those responses whose topographies were under control of contrived MOs. Future replications should try to eliminate this form of instruction in an attempt to guarantee that the mand responses are evoked solely by MOs. Moreover, the fact that 1 participant emitted a mand response during pretest suggests the possibility of extraexperimental experience with the stimuli. Future studies should attempt to control for this possibility.

The slight increase in the emission of tact responses for stimuli in Stimulus Set 2 after listener relations training for Stimulus Set 1 may suggest a lack of experimental control. However, this difficulty in achieving greater experimental control may be an inherent feature of the multiple probe design across stimulus sets. After training the first set, the establishment of a higher order operant between listener and speaker behaviors could have yielded the emergence of new tacts. It is important to note, however, that in all occurrences, the percentage of correct responses in the second set after training the first set was below criterion. Future research should attempt to replicate these findings with a design that prevents generalization across stimulus sets.

Finally, during tact posttests, only the first trial was used to assess the emergence of tacts. Following the first response, reinforcement was introduced during tact posttests to control for the possibility that subsequent failure during the mand posttest was due to lack of tacts. Future studies should attempt to replicate these results by eliminating any form of reinforcement during posttests.

Results related to the emergence of signed tacts replicate previous findings that showed the emergence of signed and spoken speaker behavior from listener behavior training (e.g., Elias et al., 2008; Greer et al., 2005). This further suggests that the transfer between listener and speaker behavior is not topography dependent, as suggested by Skinner (1957).

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